ANALYSIS OF HAULAGE FATALITIES IN BITUMINOUS-COAL MINES IN 1950

BY M. J. ANKENY AND D. S. KINGERY

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PART 1. - OCCURRENCE OF ACCIDENTS

INTRODUCTION

Coal-mine haulage ranks second as a cause of coal-mine fatalities, and the prevention of such accidents will materially improve progress in safety in the coal-mining industry. Beginning March 1950, Federal coal-mine inspectors were made responsible for completely investigating all fatal accidents in and around coal mines. During these 10 months, Federal coal-mine inspectors investigated 447 fatal accidents. This is a study of 121 of the fatal haulage accidents investigated, which constituted 27 percent of fatalities from all causes. Haulage employees represent only 12 to 15 percent of mine personnel, but, on the basis of accident frequency, their work is the most hazardous in coal mines.

Fatal haulage accidents occurred in 53 bituminous coal-producing counties representing 14 States and Alaska. The physical conditions represent a cross section of producing coal beds. Mining and transportation methods vary, from those of small hand-loading mines to those of modern mechanized mines.

During the year, one haulage accident in an Illinois bituminous mine that resulted in multiple fatalities was investigated. In it, a brakeman and two drillers, standing at the base of a slope, were killed by a runaway materials car. In each of three other mines, more than one fatal injury was caused by haulage. Fourteen operating coal companies experienced more than one fatal haulage accident each, and the fatal injuries in these mines constitute 35 percent of the fatalities investigated.

This study was designed to break down the accounts of haulage accidents into their component parts and to demonstrate how numerous contributing factors combine to cause injuries. The material included in this study "spotlights" the manner of occurrence and should be useful to coal-mine safety engineers, management and inspectors.

SUMMARY

Of the 121 fatal injuries investigated, 102 occurred underground and 14 on the surface of underground mines; 5 occurred at strip operations. A complete breakdown, by job classification, is given in table 2.

The victims were killed in 15 classified ways; the most prolific are as follows:

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		Percent of total
1.	Victim fell or stumbled into the path of moving equipment.....	23
2.	Victim was killed through contact with roof or crossbars.....	19
3.	Victim was killed as the result of derailments.....	15
4.	Victim was killed as the result of collisions.....	11
5.	Victim was killed by runaway equipment.....	11
6.	Miscellaneous.....	21

Accident prevention, to be effective, must be based upon the concept that haulage accidents are caused by either unsafe conditions, unsafe practices, or a combination of these. Some form of physical hazard was evident in more than 71 percent of the fatalities investigated and was considered to be the primary cause of 23 percent. Unsafe practices were involved in over 75 percent of the fatalities and were considered to be the primary cause of 29 percent. Unsafe practices and conditions jointly accounted for the remaining 48 percent. The most prevalent and recurring physical hazards and unsafe practices are listed below:

Physical hazards

		Percent of occurrences
1.	Irregular or scant vertical clearance.....	16
2.	Obstructed or inadequate side clearance.....	15
3.	No provision for skids or retarding devices.....	14
4.	Defective locomotive or mine cars.....	13
5.	Substahdard track conditions.....	12
6.	Defective coupling.....	8

These constituted 78 percent of the physical hazards that contributed to fatal injuries.

Unsafe practices

		Percent of occurrences
1.	Excessive speed.....	12
2.	Failure to comply with instructions or safety rules.....	11
3.	Riding in unsafe position.....	9
4.	Pushing trips.....	8
5.	Standing or walking in exposed positions.....	8
6.	Getting off or on moving equipment.....	8
7.	Confusion or disregard of signals between workmen.....	7
8.	Not looking in the direction of travel.....	6

These constituted 69 percent of the unsafe practices involved.

As shown by table 3, the inclination for motormen to have accidents does not vary much throughout the age range from 26 to 55 years. For brakemen, the age of maximum proneness to injury ranges from 25 to 35 years. Nonhaulage personnel are generally older than haulage employees; their tendency to be injured remains fairly consistent after 30 years of age.

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The ratio of injuries to job experience, as illustrated in table 3, shows that the less experienced person is very likely to be injured. However, it also indicates that the job-experience range from 3 to 5 years is critical. This is the time when many individuals accept their work as routine and are considered by management to be experienced. Supervision is reduced, and often greater responsibility is given with flexibility of assignment.

The total mining experience credited to the victims indicates that a large percentage of persons employed in coal mining have 10 or more years of mining experience. This study shows that safety and safe practices cannot be expected on the basis of experience alone. Experience must be supplemented with supervision and job instruction to reduce accidents.

Most of the haulage accidents (50 percent) occurred on haulage roads; 26 percent occurred in the face areas. Surface accidents accounted for 16 percent, whereas accidents in shafts and slopes totaled 8 percent.

Analysis of table 4 indicates certain periods during the day when haulage accidents occur most frequently. For motormen these periods seem to be during the latter part of the midnight shift, around lunch, or at quitting time during the day shift, and generally throughout the night shift.

Fatal injuries to brakemen generally reach their peak during the second part of all shifts. Accidents resulting in fatal injuries to nonhaulage personnel reach a peak toward the end of the day shift and the beginning of the afternoon shift. These are periods of maximum physical or mental strain, possibly accompanied by other disturbing influences. For example, periods after work stoppage or lunch find the individual physically and mentally underpar with a certain laxness toward the safe execution of his work. A normal psychological relapse is induced, partly by fatigue, toward the end of any working shift. During this period the individual visualizes the end of his work and mentally plans his postwork activity, or he may be required to extend greater effort to complete his work on time.

This summary indicates that fatal haulage accidents occurred in essentially the same manner and from similar contributing causes during 1950 as in previous years. The probability is that unless concerted effort is directed toward reducing these recurring and almost standard causes, the accident record for 1960 will still parallel the annual records of 1940 to 1950.

A significant fact is that most of these fatal accidents were preventable. More attention to duty, foresight, and common sense, together with greater appreciation of contributing factors will prevent many similar accidents.

RECOMMENDATIONS

The physical hazards and unsafe practices listed imply their own corrective measures. However, their elimination is complicated by numerous indefinite influencing factors. It is doubtful if any standard formula or physical solution can be developed to solve all contributing and not always obvious agents. The solution must come through sincere effort and cooperation by both management and employees striving together toward the common goal.

Management has the primary responsibility for haulage safety. The following suggestions are made to management with the thought that compliance will reduce haulage accidents.

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1. Select transportation employees on the basis of physical ability, mental qualifications, and stability.

2. Establish some form of job-safety training and certification for transportation employees. Train relief employees frequently to assure their competence.

3. Promulgate a reasonable set of safety rules, suitable to conditions, to govern the actions of haulage employees.

4. Conduct regular meetings between officials and haulage employees at which ideas concerning safety and efficiency can be discussed, the good suggestions to be acted upon.

5. Plan the haulage system on the basis of present and projected requirements. Consider the type of haulage equipment now in use or anticipated.

6. Establish a preventive maintenance program whereby defective haulage equipment is taken out of service before it breaks down.

7. Improve supervision of haulage employees to assure corrective measures and necessary job instruction before accidents occur.

8. Survey the transportation system to ascertain if the equipment is adequate for the job or if it is too light, too high, too wide, or otherwise not suitable.

9. Place definite responsibility on one individual for the operation, maintenance, and safety of the transportation system.

10. Provide the necessary accessories for safe operation, such as skids or retarding devices, rerailers, lifting jacks, fire extinguishers, and other safety equipment.

11. Establish a positive communication or dispatching system with safety auxiliaries, such as automatic traffic-control blocks, signals, and switches.

12. Provide equipment designed to afford a comfortable and safe place for workers to ride.

13. Promulgate standards on the basis of engineering and safety knowledge to govern the lay-out, installation, and maintenance of haulageways, shafts, and slopes, with emphasis on the following:

(a) Track standards. - alinement, gradient, size of rails, ballasting, drainage, maintenance, etc.

(b) Haulage roads. - vertical clearance over equipment, side clearance, shelter holes, trolley wire, electrical installations, illumination, and timbering.

Employees should accept joint responsibility for many of the previous recommendations, and, in the interest of their own safety, they should comply with the following suggestions:

1. Study the job; analyze and plan operations for maximum safety.

2. Study the equipment; learn its performance, limitations, and safe operating conditions.

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3. Check equipment for malfunction before starting work.

4. Study potential hazards; how they occur, why they occur, and corrective measures.

5. Comply with instructions to best of ability.

6. Consult foremen when unfamiliar with proper procedures.

7. Report all hazards and deficiencies to officials.

8. Cooperate with company safety policy at all times.

9. Be sure that all signals are understood before acting.

10. Operate equipment only when mentally alert and physically up to par.

11. Always keep operated equipment under control.

12. When operating equipment, consider the potential hazards to other workers.

13. Develop safety consciousness for personal safety as well as the safety of others.

TABLE 1. - Fatal haulage accidents, 1950, by States

State	Fatal accidents	Percent of accidents investigated
West Virginia	58	47.7
Kentucky	16	13.2
Pennsylvania	15	12.8
Illinois	10	8.3
Alabama	4	3.3
Ohio	4	3.3
Virginia	3	2.5
Wyoming	3	2.5
Indiana	2	1.6
North Dakota	1	.8
Colorado	1	.8
New Mexico	1	.8
Oklahoma	1	.8
Utah	1	.8
Territory of Alaska	1	.8
Total	121	100.0

CLASSIFICATION OF EMPLOYEES KILLED

The job classification was based upon actual work performed at the time of accident. For example, a fire boss was killed while operating a motor; inasmuch as he was exposed to hazards confronted by motormen, he was listed among motormen. Accidents occurring in shafts and slopes were listed as underground accidents.

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TABLE 2. - Job classification of victims

	Number	Percent of total		Number	Percent of total		Number	Percent of total
Underground:			Surface:			Strip mines:		
Motormen	40	33.0	Motormen	1	0.9	Truck drivers	4	3.3
Brakemen	28	23.1	Railroad-car droppers	4	3.3	Railroad-car droppers	1	.9
Drivers	5	4.2	Drivers	1	.8	Total	5	4.2
Shuttle-car operators	4	3.3	Truck drivers	1	.8	Total bituminous	121	100
Nonhaulage personnel	25	20.6	Nonhaulage personnel	7	5.8			
Total	102	84.2	Total	14	11.6			

TABLE 3. - Recapitulation of haulage accidents, work classification and miscellaneous data

Years	Motormen	Brakemen	Nonhaulage personnel	Drivers	R. R. car droppers and truck drivers	Shuttle-car operators	Total
Age range							
Up to 20	1	0	0	1	1	0	3
20 - 25	0	2	1	0	1	1	5
26 - 30	8	8	1	1	3	1	22
31 - 35	5	6	3	1	1	1	17
36 - 40	5	4	2	0	3	1	15
41 - 45	7	4	3	1	0	0	15
46 - 50	3	2	4	0	1	0	10
51 - 55	10	0	6	0	0	0	16
56 - 60	0	2	7	1	0	0	10
Over 60	1	0	4	1	0	0	6
Average	41	35	50	41	32	30	41.2
Job experience							
Up to 1	7	5	4	3	3	1	23
1 - 2	8	3	5	0	4	3	23
3 - 5	7	14	7	2	0	1	31
6 - 10	8	2	5	1	2	0	18
11 - 15	4	1	3	0	1	0	9
16 - 20	3	2	1	0	0	0	6
Over 20	4	0	2	0	0	0	6
Average	8	5	8	4	4	2	6.3
Total experience							
Up to 1	1	0	1	2	3	0	7
1 - 2	1	1	0	0	1	2	5
3 - 5	4	4	2	0	1	0	11
6 - 10	5	5	3	1	2	0	16
11 - 20	13	11	5	1	2	2	34
21 - 30	8	3	6	1	0	0	18
31 - 40	4	1	6	0	0	0	11
Over 40	1	0	1	1	0	0	3
Average	18	14	23	17	5	10	16.5

TABLE 4. - Recapitulation of haulage accidents time of day and location

Description	Motormen	Brakemen	Nonhaulage employees	Drivers	R. R. car droppers and truck drivers	Shuttle-car operators	Total
Time of day:							
12.00 - 1.00 A.M.	1	0	0	0	0	0	1
1.01 - 2.00	0	1	0	0	0	0	1
2.01 - 3.00	1	1	2	0	0	0	4
3.01 - 4.00	1	0	0	0	0	0	1
4.01 - 5.00	2	0	0	0	0	0	2
5.01 - 6.00	2	0	0	1	0	0	3
6.01 - 7.00	2	2	1	0	0	0	5
7.01 - 8.00	2	2	1	1	1	0	7
8.01 - 9.00	0	0	4	0	0	0	4
9.01 - 10.00	3	1	1	0	1	0	6
10.01 - 11.00	1	3	1	0	0	1	6
11.01 - 12.00 Noon	3	1	1	0	1	1	7
12.01 - 1.00 P.M.	2	2	1	1	0	0	6
1.01 - 2.00	0	4	5	0	2	1	12
2.01 - 3.00	1	2	2	1	2	0	8
3.01 - 4.00	5	1	4	0	0	0	10
4.01 - 5.00	3	1	2	0	0	0	6
5.01 - 6.00	2	1	1	1	0	0	5
6.01 - 7.00	1	1	2	1	1	0	6
7.01 - 8.00	1	0	1	0	0	0	2
8.01 - 9.00	2	0	0	0	1	0	3
9.01 - 10.00	2	0	0	0	0	0	2
10.01 - 11.00	3	2	0	0	0	0	5
11.01 - 12.00 M. Night	0	3	2	0	1	1	7
Location:							
On haulageroads	32	20	6	3	-	-	61
In face regions	7	7	11	2	-	4	31
On surface	1	0	7	1	10	-	19
On slopes	1	1	6	0	-	-	8
In shafts	0	0	2	0	-	-	2

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PART 2. - CAUSES OF ACCIDENTS

INTRODUCTION

This part of the study is devoted to a more complete breakdown of contributing physical hazards and unsafe practices that cause haulage fatalities. The purpose is to provide a complete story that will serve as a reference for each type of accident experienced. Consequently, each job classification is considered separately in the following order:

1. Motormen
2. Brakemen
3. Nonhaulage employees
4. Animal drivers
5. Railroad car droppers and truck drivers
6. Shuttle car operators

MOTORMEN

Persons operating locomotives were involved in 42 fatal injuries, broken down as follows:

Underground:	Number
Regular haulage personnel	30
Temporary or substitute employees[1]	10
Total	40
Surface:	
Regular haulage personnel	-
Temporary or substitute employees[1]	1
Total	1
Total motormen	41

1/ Temporary or substitute employees constitute those relatively inexperienced men who fill in as substitutes or take a locomotive to run some errand or to facilitate work.

The ways in which motormen experienced fatal injuries are listed under five general classifications. These general descriptions, when supplemented with the action of the victim, the contributing physical hazards, and unsafe practices, "spotlight" the causes of accidents and imply corrective measures.

Manner in which motormen suffered fatal injuries:

	Number
1. Victim either fell or stumbled and was killed by the moving locomotives or trips	12
2. Victim was killed as the result of contact with roof or crossbars	9
3. Victim was killed as the result of collisions between moving or parked equipment	7
4. Victim was killed by the derailment of locomotives or trips	8
5. Victim was killed by wrecked or runaway locomotives or trips	5

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The following pertinent data illustrate the physical hazards and unsafe practices for each of the preceding types of occurrence.

Manner of occurrence:

	Number of occurrences
1. Victim either fell or stumbled and was killed by moving locomotive or trip.	
(a) Action of victim at time of accident.	
1. Jumping out of defective locomotive (electrical)...	3
2. Running ahead of moving locomotive.....	2
3. Rising in locomotive cab.....	1
4. Fell out of locomotive caused by reversed direction lever.....	1
5. Fell out of locomotive caused by bucking at broken rail.....	1
6. Jumped out of locomotive speeding out of control...	1
7. Getting off moving locomotive to throw switch.....	1
8. Fell off locomotive caused by jerking action of a slack trip with light motor.....	1
9. Not determined.....	1
(b) Physical hazards contributing to accident.	
1. Defective locomotives (electrical).....	3
2. Defective locomotive brakes.....	2
3. Substandard track.....	1
4. Lack of skids or retarding devices.....	1
5. Inadequate side clearance.....	1
(c) Hazardous practices involved.	
1. Getting off moving equipment.....	3
2. Running ahead of moving equipment.....	2
3. Rising up in locomotive cab.....	1
4. Excessive speed.....	1
5. Failure to change direction lever.....	1
6. Failure to comply with known rules or instructions.	1
7. Excessive size trip for weight of locomotive.....	1
8. Failure to signal or to wait on signal.....	1
9. Not watching the direction of travel.....	1
(d) Contributory causes.	
1. Inexperience.....	3
2. Inattention.....	1
3. Haste to quit work.....	1

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	Number of occurrences
2. The victim was killed as the result of contact with roof or crossbars.	
(a) Action of victim at time of accident.	
1. Changing trolley pole or other work in cab.....	3
2. Evident normal operation.....	3
3. Starting locomotive with direction lever reversed..	1
4. Operating locomotive while out of control.....	1
5. Standing by locomotive during power interruption...	1
(b) Physical hazards contributing.	
1. Irregular or inadequate vertical clearance.....	4
2. Defective equipment.....	2
3. Lack of skids or retarding devices.....	1
4. Excessive grade for trip size.....	1
5. Poor illumination.....	1
(c) Hazardous practices involved.	
1. Rising in locomotive cab.....	4
2. Failure to comply with instructions.....	2
3. Failure to change the direction lever or shut off controller.....	2
4. Standing in exposed position.....	1
5. Excessive speed.....	1
6. Excessive trip for locomotive weight.....	1
7. Not facing the direction of travel.....	1
(d) Contributory causes.	
1. Inexperience.....	3
2. Inattention.....	3
3. Physical handicap.....	1
3. Victim was killed as the result of collisions between moving or parked equipment.	
(a) Action of victim at time of accident.	
1. Operating locomotive that struck moving or parked equipment.....	5
2. Standing by parked locomotive.....	2
(b) Physical hazards contributing.	
1. Lack of warning or trip lights.....	4
2. Lack of or inadequate safety blocks or retarding devices.....	2
3. Inadequate dispatching failure to provide traffic safety blocks.....	2
4. Defective coupling.....	1
5. Poor visibility.....	1

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	Number of occurrences
(c) Hazardous practices involved..	
1. Parking unattended equipment on haulage roads.....	3
2. Excessive speed for conditions.....	3
3. Failure to comply with standard practices.....	2
4. Following too close behind moving equipment.....	2
5. Failure to signal or ignoring signals.....	2
6. Excessive trip size for locomotive weight.....	1
7. Pushing cars.....	1
(d) Contributory causes.	
1. Inattention.....	3
2. Inexperience.....	1
3. Physical or mental lapse.....	1
4. Victim was killed by action of derailed locomotives or trips.	
(a) Crushed between locomotive, rib or crossbar.....	4
(b) Struck by dislodged crossbars.....	2
(c) Crushed between locomotive and roof.....	1
(d) Crushed between locomotive and cars.....	1
(e) Action of victim at time of accident.	
1. Knocked off locomotive by derailment.....	4
2. Jumped off derailed locomotive.....	3
3. Rerailing mine car.....	1
(f) Physical hazards contributing.	
1. Substandard track conditions.....	5
2. Inadequate or obstructed side clearance.....	2
3. Lack of skids or retarding devices.....	1
4. Locomotive too light for job.....	1
5. Substandard entry timbering.....	1
(g) Hazardous practices involved.	
1. Excessive speed.....	3
2. Excessive size of trips.....	2
3. General reckless operation.....	2
4. Confused or improper signals.....	1
(h) Contributory cause.	
1. Inattention.....	2
2. Inexperience.....	1

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	Number of occurrences
5. Victim was killed by wrecked or runaway trips.	
(a) Action of victim at time of accident.	
1. Operating locomotive struck by split runaway trips.....	4
2. Operating locomotive out of control.....	1
(b) Physical hazards contributing.	
1. Lack of skids or retarding devices.....	3
2. Defective coupling.....	2
3. Steep grade.....	1
(c) Hazardous practices involved.	
1. Following too close to moving equipment.....	2
2. Failure to use trip lights.....	2
3. Excessive size of trip.....	1
4. Failure to follow regular procedure.....	1
5. Leaving locomotive unattended.....	1
6. Unauthorized playing with equipment.....	1
7. Failure to comply with instructions.....	1
(d) Contributing causes.	
1. Inattention.....	2
2. Inexperience.....	1

Case Records of Fatal Haulage Accidents

1. The victim, making a fire boss run on a light motor, evidently rose to replace the trolley pole. He was not familiar with the irregular top clearance of the entry and was crushed between the roof and locomotive at a point where the clearance was only 8-1/2 inches.

2. The victim, pulling 52 loads with a 12-ton locomotive down a 2-percent grade over poor track, endeavored to jump from the derailed locomotive and was killed in the subsequent wreck.

3. The victim, who had only 1 day's experience as a motorman, forgot about the position of the direction lever, stood up in the cab, put on the controller, and fell out of the cab when the motor started.

4. The victim, pulling a 30-percent larger than normal trip down a 5-percent grade without retarding devices, was killed when the trip derailed.

5. The victim, operating a locomotive with one car attached, struck a mining machine parked on the main haulage road just off the junction between tracks.

6. The victim was pulling a trip up a 6-percent grade when the controller box blew up, cuasing him to jump in front of the moving trip.

7. The victim got off a moving trip and ran ahead to throw a switch, stumbled, and fell in front of the trip.

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8. The victim, a one-armed extra motorman, was crushed between the roof and locomotive while trying to reset the trolley pole of a runaway locomotive and trip.

9. The victim, sitting on the bumper of the locomotive after a power interruption, rose and struck a low crossbar 5-1/2 inches over the locomotive when the power was resumed. He had failed to shut off the controller.

10. The victim, a trackman, took a battery locomotive, against instructions, and was crushed between the roof and locomotive when he rose up.

BRAKEMEN

Persons working as brakemen or trip riders were involved in 30 underground fatal injuries, broken down as follows:

	Number
Regular haulage personnel.....	24
Temporary or substitute employees.....	4
Total.....	28

No accidents involving brakemen occurred on the surface. The ways in which brakemen experienced fatal injuries are listed under five general classifications. As the brakemen and motormen constitute haulage crews, they are exposed to similar hazards, and their general injury classifications are the same.

Manner in which brakemen suffered fatal injuries:

	Number
1. Victim was killed as the result of contact with roof or crossbars.	8
2. Victim was killed as the result of derailed cars or locomotives...	8
3. Victim either fell or stumbled and was killed by moving cars or locomotives.....	7
4. Victim was killed as the result of collisions between equipment...	2
5. Victim was killed by runaway trips.....	2
6. Victim was crushed between rib and car.....	1

The following pertinent data illustrate the physical hazards and unsafe practices for each preceding manner of accident occurrence.

Manner of occurrence:	Number of occurrences
1. Victim was killed as the result of contact with roof or crossbars.	
(a) Action of victim at time of accident.	
1. Riding the stirrup step of locomotive.....	4
2. Riding on top of loaded car.....	1
3. Riding between cars.....	1
4. Coupling cars in motion.....	1
5. Jumping on top of locomotive.....	1

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	Number of occurrences
(b) Physical hazards contributing.	
1. Irregular or inadequate vertical clearance.....	6
2. Lack of safe place for brakeman to ride.....	4
3. Poor visibility.....	2
(c) Unsafe practices involved.	
1. Riding in unsafe position.....	4
2. Excessive speed.....	2
3. Violating safety rules or instructions.....	1
4. Jumping on moving equipment.....	1
5. Coupling cars in motion.....	1
6. Not watching direction of travel.....	1
7. Confused signals between motor crew.....	1
8. Pushing trip.....	1
(d) Contributory causes.	
1. Lack of attention, either motorman or brakemen.....	4
2. Inexperience.....	2

2. Victim was killed as the result of derailed cars or locomotives.

Killed in wreck.....	3
Struck by derailed car.....	2
Crushed against rib.....	2
Crushed against roof.....	1
(a) Action of victim at time of accident.	
1. Jumping off moving trip of locomotive.....	3
2. Coupling empty cars.....	1
3. Riding stirrup step of locomotive.....	1
4. Walking along clearance side.....	1
5. Riding front car of pushed trip.....	1
6. Riding on top of locomotive.....	1
(b) Physical hazards contributing.	
1. Substandard track conditions.....	3
2. Obstructed or inadequate clearance.....	2
3. Failure to provide skids or retarding devices.....	2
4. Irregular vertical clearance.....	1
5. No safe place for brakeman to ride.....	1
(c) Hazardous practices involved.	
1. Pushing trips.....	2
2. Riding in unsafe position.....	2
3. Getting off moving equipment.....	2
4. Violating safety rules.....	1
5. Excessive speed.....	1
6. Not watching direction of travel.....	1

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	Number of occurrences
(d) Contributory causes.	
1. Excessive fatigue	1
2. Inattention	1

3. Victim either fell or stumbled and was killed by moving cars or locomotives.

(a) Action of victim at time of accident.	
1. Running ahead of moving trip	2
2. Riding front bumper of trips pushed	2
3. Kicking switch from moving trip	1
4. Getting off moving trip	1
5. Walking along haulage road	1
(b) Physical hazards contributing.	
1. Pushing cars excessive distances	3
2. Substandard condition of haulage road	2
3. Obstructed or inadequate clearance	1
4. Switch without parallel throw	1
5. Lack of safe place for brakeman to ride	1
(c) Unsafe practices involved.	
1. Pushing trips	5
2. Riding in unsafe positions	2
3. Running ahead of moving equipment	2
4. Excessive speed	2
5. Failure to observe signals	1
6. Kicking switch latch from moving equipment	1
7. Getting off moving trip	1
(d) Contributory causes.	
1. Inattention, motorman or brakeman	2
2. Inexperience	1

4. Victim was killed as the result of collisions between equipment.

(a) Action of victim at time of accident.	
1. Riding front car of trip pushed	1
2. Standing beside mine car	1
(b) Physical hazards contributing.	
1. Inadequate dispatching	1
2. Lack of visibility	1

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	Number of occurrences
(c) Unsafe practices involved.	
1. Excessive speed	1
2. Not checking side track	1
3. Standing in unsafe location	1
(d) Contributory causes.	
1. Inexperienced motorman	1

5. Victim was killed by runaway trips.

6. Victim was crushed between rib and mine car.

(a) Action of victim at time of accident.	
1. Riding side of mine car while dropping trip by gravity	1
2. Running ahead of a free moving trip	1
3. Working on moving trip from tight side	1
(b) Physical hazards contributing.	
1. Failure to provide skids or retarding devices	2
2. Poor visibility	1
3. Unsafe transportation practice	1
(c) Unsafe practices involved.	
1. Riding in unsafe position	1
2. Working ahead of free moving trip	1
3. Disregard of instructions	1
4. Working from tight side	1
(d) Contributory causes.	
1. Inexperience	1

Case Records of Fatal Haulage Accidents

1. The victim, riding the front bumper of a pushed trip, got off in front of the moving trip and was killed.

2. The victim was crushed between the rib and a car while endeavoring to release the brake from a moving car. He was working from the tight side.

3. The victim was killed while endeavoring to get out of the front car of a pushed trip about to collide with standing loads on a side track.

4. The victim, riding the deck of a locomotive, was knocked off and killed by a derailment caused by cars pushing locomotive downgrade at excessive speed.

5. The victim was crushed between the roof and locomotive at a point of 8 inches vertical clearance while he was riding the front stirrup of the locomotive.

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6. The victim was run over by a trip of 40 empty cars he was dropping into an entry controlled only by a few brakes. The victim was acting as a substitute brakeman for that day.

7. The victim, while riding a stirrup on the locomotive, was crushed between the roof and locomotive at a point of only 3-3/4 inches vertical clearance.

8. The victim, while coupling cars in motion, was rolled between the roof and loaded cars at a point of irregular vertical clearance.

9. The victim was struck by a derailed car while walking on the clearance side.

10. The victim was squeezed between a derailed car and the rib as he stepped off the front bumper of a pushed trip of 44 cars.

11. The victim was crushed between the roof and the top of a loaded car he was riding.

12. The victim was crushed between the roof and loaded cars as he was riding between cars of a moving trip.

13. The victim was crushed between the roof and the top of a moving locomotive he was endeavoring to mount.

NONHAULAGE EMPLOYEES

Nonhaulage employees were involved in 30 fatal injuries, broken down as follows.

	Underground fatalities	Surface fatalities
Officials	4	2
Machine operators or helpers	6	0
Coal loaders	4	0
Underground general labor	4	0
Trackmen	3	1
Surface general labor	0	3
Driller	1	
Shotfirer	1	
Cager	1	
Maintenance man		1
Unclassified	1	
Total	25	7

It is significant that nonhaulage personnel contributed over 26 percent of the fatalities investigated and indicates that more individual safety training and instructions to all employees would accomplish much toward improving the haulage safety record.

The ways in which nonhaulage employees suffered fatal injuries are similar to those in which regular haulage personnel was injured. Accidents occurred at scattered locations while the individuals were engaged in various duties. Salient influencing factors are that nonhaulage employees usually are older men and often are

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injured while performing new duties and assignments. This indicates that such employees often are not aware of, or refuse to consider, impending or inherent hazards while doing routine work on or around haulage equipment. Their training and instruction often is nominal and does not include fundamental haulage safety. Consequently, they are not prepared when suddenly exposed to haulage hazards.

The following pertinent data illustrate the manner of occurrence and contributing causes of accidents to nonhaulage personnel.

Manner in which nonhaulage employees suffered fatal injuries:

	Number
1. Victim was killed by runaway locomotive or cars	7
2. Victim was struck by pushed or free moving cars	5
3. Victim was crushed between the face rib or timber supports and cars or locomotives	4
4. Victim was killed in collisions between equipment	2
5. Victim was killed by accidents while being hoisted or lowered in a shaft	2
6. Victim was crushed between roof and car	2
7. Victim was caught in moving conveyor	2
8. Victim was killed by derailments	2
9. Miscellaneous	5

Manner of occurrence.

	Number of occurrences
1. Victim was killed by runaway locomotives or cars.	
Struck by runaway on slope or incline	5
Struck by runaway on entry	1
Riding in runaway man trip	1
(a) Action of victim at time of accident.	
1. Standing or sitting exposed to hazards	4
2. Normal routine operation	2
3. Cleaning slope haulage track	1
4. Rose in man trip	1
(b) Physical hazards contributing.	
1. Defective clevis or couplings	4
2. Lack of skids or retarding devices	3
3. Lack of stop blocks or derails	2
4. Restricted visibility	1
5. Track switch without parallel throws	1

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	Number of occurrences
(c) Unsafe practices involved.	
1. Standing or sitting in hazardous place.....	4
2. Failure to follow instructions.....	3
3. Inadequate blocking of standing cars.....	1
4. Failure to re-aline track switches.....	1
5. Excessive speed.....	1
6. Using inexperienced motorman for mantrip.....	1
(d) Contributory causes.	
1. Inattention.....	4
2. Inexperience.....	1

2. Victim was struck by pushed or free-moving cars.

(a) Action of victim at time of accident.	
1. Normal work on entry or side track.....	3
2. Walking by car dump.....	1
3. Standing by loaded cars.....	1
(b) Physical hazards contributing.	
1. Lack of proper warning signs.....	1
2. Ineffective dead block.....	1
3. Poor visibility.....	1
(c) Unsafe practices involved.	
1. Pushing cars.....	2
2. Standing in unsafe position.....	1
3. Starting work without signaling.....	1
4. Not checking safety of other workers.....	1
5. Failure to block standing trip adequately.....	1
(d) Contributory causes.	
1. Inattention.....	3
2. Age of victim.....	1
3. Haste to quit work.....	1

3. Victim was crushed between the face, rib or timber supports and cars or locomotives.

(a) Action of victim at time of accident.	
1. Loading coal at the working face.....	1
2. Tramming face equipment.....	1
3. Working on or from moving equipment.....	1
4. Standing on tight side of room.....	1

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	Number of occurrences
(b) Physical hazards contributing.	
1. Substandard side clearance.....	2
2. Ineffective attachment of rope to car.....	1
(c) Unsafe practices involved.	
1. Failure to block standing car securely.....	1
2. Pushing too long a trip into room.....	1
3. Failure to follow instructions.....	1
4. Working on moving equipment.....	1
5. Tramming equipment from tight side.....	1
6. Standing or sitting in exposed position.....	1
7. Confused signals between crews.....	1
(d) Contributory causes.	
1. Inattention.....	2

4. Victim was killed by collisions between equipment.

(a) Action of victim at time of accident.	
1. Endeavoring to get out of man trip.....	1
2. Moving supply jeep without instruction.....	1
(b) Physical hazards contributing.	
1. Lack of adequate traffic control or signal system..	1
2. Placing inexperienced motorman on man trip.....	1
(c) Unsafe practices involved.	
1. Failure to follow instructions.....	1
2. Not looking in the direction of travel.....	1
3. Failure to clarify inadequate instruction.....	1
4. Excessive speed.....	1
(d) Contributory causes.	
1. Inexperienced motorman and foreman.....	1

5. Victims killed by accidents occurring while hoisted or lowered in shafts.

(a) Action of victim at time of accident.	
1. Riding cage that tilted while descending.....	1
2. Attempting to jump from moving cage.....	1

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	Number of occurrences
(b) Physical hazards contributing.	
1. Defective shaft guide bunton.....	1
2. Inadequate testing and maintenance program.....	1
(c) Unsafe practices involved.	
1. Hoisting cage without proper signal.....	1
6. Victim was crushed between roof and cars.	
(a) Action of victim at time of accident.	
1. Climbing on moving car.....	1
2. Riding in man trip.....	1
(b) Physical hazards contributing.	
1. Inadequate vertical clearance.....	1
2. Failure to secure adequately drop bottom doors of cars used for man trips.....	1
(c) Unsafe practices involved.	
1. Climbing on moving loaded car.....	1
2. Riding outside of car.....	1
3. Excessive speed.....	1
4. Failure to follow regular procedures.....	1
7. Victim was caught in moving conveyor.	
(a) Action of victim at time of accident.	
1. Crossing over a moving belt conveyor.....	1
2. Scraping sludge from moving belt conveyor.....	1
(b) Physical hazards contributing.	
1. Lack of conveyor control safety devices.....	1
(c) Unsafe practices involved.	
1. Working on moving conveyor.....	1
2. Crossing over moving conveyor.....	1
(d) Contributory cause.	
1. Unwillingness to travel around the conveyor in low coal or use the crossover bridge.....	1
8. Victim was killed in derailments.	
(a) Action of victim at time of accident.	
1. Standing at loading point.....	1
2. Standing between empty and loaded tracks.....	1

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	Number of occurrences
(b) Physical hazards contributing.	
1. Inadequate or obstructed clearance.....	1
(c) Unsafe practices involved.	
1. Standing in unsafe location.....	2
2. Haste to quit work.....	1
3. Work performed by persons not familiar with the procedure.....	1
4. Hazardous rerailing practices.....	1
9. Miscellaneous.	
(a) Action of victim at time of accident.	
1. Standing in way of surface railroad cars.....	2
2. Riding cutting bar of moving mining machine.....	1
3. Standing in way of flying cable under tipple.....	1
4. Dumping car of coal.....	1
(b) Physical hazards contributing.	
1. Substandard vertical clearance.....	1
2. Lack of safety chains on car hoist.....	1
3. Lack of guard rails on dump platform.....	1
4. Makeshift car dump installation.....	1
(c) Unsafe practices involved.	
1. Standing in unsafe positions.....	3
2. Riding on cutter bar of mining machine.....	1
(d) Contributory causes.	
1. Inattention.....	2
2. Age and physical condition.....	1

Description of Accidents

1. The victim, a trackman, was killed when he failed to heed the warning of the motor crew. He stood back of a poorly made dead block and was killed when a runaway trip crashed through.

2. The victim, riding in a 2-car man trip, was killed when he rose to throw an electrically operated derail switch. The trip was running out of control down a 3-percent grade toward the derail. The other men jumped out of the cars and were not injured.

3. The victim and three other men were loading coal from the slope haulageway. The cars were chained together; while hoisting the trip, a clevis broke, permitting two cars to run free down the slope, only the victim was seriously injured.

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4. The victim, a driller, was struck by a runaway three-car trip. This trip was poorly blocked on a 3-percent grade and was set in motion when the automatic coupling of a pushed car bumped the standing trip and failed to lock.

5. The victims, a brakeman and two drillers, were struck by a runaway materials car and killed while waiting at the slope bottom for the man trip. The men were not in the man-trip waiting station or protected by a shelter hole. Near quitting time the top crew endeavored to switch the materials car off the main slope into the material-storage siding, using a locomotive instead of the hoisting rope. The switch between the main slope and materials siding was not equipped with a switch throw. While making this switch, the motor entered the siding, but the latches were knocked toward the main slope, and the materials car followed this direction. Upon reaching the frog, the car became uncoupled, bumped the motor out of the way, and ran free down the slope.

6. The victim, a laborer pumping water from a side track, was killed when struck by cars pushed onto the side track by the motor crew.

7. The victim, a mine official, was caught in a moving belt conveyor, which he endeavored to cross. There was a cross over bridge 73 feet away.

8. The victim, a mine official, was riding the rear bumper of the last car of an inbound man trip. He was crushed against the roof when the outby drop-bottom door of the mine car opened, caught on a tie, and buckled into the roof. No one riding inside the car was injured.

9. The victim, a car dropper working on the cage near the end of the shift, was killed when he jumped from the moving cage. Signals were confused, but there was no need for the deceased to jump.

10. The victim, a loading head operator was killed while standing by two cars of posts waiting for the return of a locomotive. Another motor crew pushed a trip of empties into the side track, bumping the standing loads and the victim.

11. The victim, a stoper operator, was killed while tramming a caterpillar-mounted air compressor from the tight side of an entry.

12. The victim was standing under an elevated, running conveyor belt scraping frozen sludge from the return surface of the belt. He was scraping in the direction of travel and was caught, pulled into the belt, and crushed between the rollers.

13. The victim was helping to move three frozen cars from under the tipple. The cars were connected to a hoist by a wire rope. After moving the cars 3 feet, the rope broke, whipped about, and struck the deceased.

14. The victim, an outside laborer, while endeavoring to release the rope from a moving mine car, walked backward and stumbled, falling under the car.

ANIMAL DRIVERS

Persons driving animals were involved in the following number of fatal injuries.

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	Number
Underground:	
Regular drivers	3
Inexperienced substitute drivers	2
Total underground	5
Surface:	
Inexperienced driver	1
Aggregate total	6

Manner in which drivers suffered fatal injuries.

	Number of occurrences
1. Fell under or into path of moving cars	4
2. Collision between equipment, and derailments	2

The following data illustrate the causes for each occurrence.

1. Victim fell under or into the path of moving cars.

(a) Action of victim at time of accident.

1. Riding between cars	1
2. Endeavoring to mount or dismount from the front bumper of a moving car	2
3. Endeavoring to unhook the tail chains while standing on a moving car	1

(b) Physical hazards contributing.

1. Inadequate side clearance	2
2. Adverse grades	2
3. Inadequate top clearance	1
4. Substandard track conditions	1

(c) Unsafe practices involved.

1. Failure to set brakes	2
2. Riding in unsafe positions	2
3. Getting off or on moving cars	2
4. Riding front bumper of free moving cars	2
5. Working from moving equipment	1

(d) Contributory causes.

1. Inexperience	2
2. Physical condition (age)	1

2. Collisions between equipment 1

Crossbar leg knocked out by derailment 1

(a) Action of victim at time of accident.

1. Standing by loaded mine car	1
2. Riding the rear bumper of mine car	1

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	Number of occurrences
(b) Physical hazards contributing.	
1. Lack of adequate clearance	2
2. Lack of trip lights	1
3. Substandard timbering	1
4. Adverse grade	1
(c) Unsafe practices involved.	
1. Failure to aline switch properly	1
2. Pushing cars	1
3. Failure to stand clear	1
(d) Contributory causes.	
1. Physical condition (age)	1
2. Inexperience	1

Remarks.

Accidents to drivers parallel those experienced by motormen and brakemen. The speed of operation and the size of trips are not as great, but usually the cars and haulage roads are in a more hazardous condition, and an animal is more temperamental than a locomotive. Obviously this calls for experienced personnel. Regardless of the intelligence or training of the animal, some one must throw the switches, couple the cars, make the hitchings, and control the speed. Three of the drivers killed were inexperienced or substituting for the day. Two were 60 years of age or older, and one was less than 20 years old. There is a trend toward the use of older men for drivers in many hand-loading mines. The reason is, a man too old to load coal can handle the job of driving and continue to be self-sustaining. Actually, a driver must have physical stamina, mental and muscular coordination, an alert mind, patience, and a background of mining experience. Lack of appreciation of these requisites and the inherent hazards to animal drivers contribute greatly to this type of accident.

Description of Accidents

1. The victim, evidently riding between two cars down a grade, endeavored to set the brakes of one car. While doing this, he struck his head at a point of low vertical clearance and fell between the cars.

2. The victim, a substitute driver, forgot to realine the switch after the main line crew left. When they returned, pushing their trip, it caught the victim, who was waiting at the side track.

3. The victim got off the rear of a moving car, passed around the car, and attempted to mount the front bumper. He slipped and fell under the car.

4. The victim was driving a string team attached to a loaded car. He moved from the rear of the car to the front bumper, endeavored to release the tail chain, and fell under the moving car.

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RAILROAD CAR DROPPERS AND TRUCK DRIVERS

Persons dropping railroad cars or driving trucks were involved in ten fatal injuries broken down as follows:

	Surface accidents at underground mines	Strip mines
Railroad car droppers	4	1
Truck drivers	1	4
	5	5

The ways in which these individuals experienced fatal injuries are listed under six general classifications. As expected, railroad-car droppers either fell or jumped off moving cars. Truck drivers were killed in five different ways. The following physical hazards and unsafe practices point out the causes for these accidents and imply corrective measures.

Manner in which victims suffered fatal injuries.

	Number of occurrences
1. Fell or jumped while dropping railroad cars	5
2. Crushed between two trucks while standing in exposed position	1
3. Crushed by bed of truck while trying to dislodge coal	1
4. Struck by railroad locomotive	1
5. Crushed under truck at edge of refuse dump	1
6. Jumped from speeding truck out of control	1
(a) Physical hazards contributing.	
1. Ice and snow conditions	2
2. Inadequate lighting	2
3. Blind approach to railroad crossing	1
4. Defective truck	1
5. Lack of stop block at the edge of refuse dump	1
6. Makeshift dirt road with steep grades	1
7. Overloading truck	1
(b) Unsafe practices involved.	
1. Taking unnecessary chances	2
2. Failure to use safety belts	2
3. Standing or working from a hazardous position	2
4. Not looking in the direction of travel	2
5. Failure to stop at railroad crossing	1
6. Backing equipment without watching	1
7. Failure to secure standing cars	1
8. Backing too close to the edge of dump	1
9. Failure to signal properly	1

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	Number of occurrences
10. Disregard for warning.....	1
11. Parking railroad cars on switches.....	1

(c) Contributory causes.

1. Inattention.....	3
2. Inexperience.....	1

Description of Accidents

1. The victim, a truck driver, backed too close to the edge of a waste dump, causing the material to slide and the truck to turn over.

2. The victim, while standing on the running board observing the action of the coal-loading shovel in a strip mine, was struck by a second truck backing into the loading zone.

3. The victim, a railroad car dropper, uncoupled four cars and while doing so released the air. He could not control the speed of the trip down a 2-percent grade by the hand brakes alone and was killed when the free-running trip struck a loaded railroad car.

4. The victim was dropping three railroad cars down No. 2 track, controlling the trip by the brake on the front car. The moving trip struck standing cars on No. 1 switch. These cars extended onto the No. 2 right of way. The deceased was caught between the corner of a protruding car and the car he was riding.

SHUTTLE-CAR OPERATORS

Persons operating shuttle cars were involved in the following number of fatal injuries.

Underground:	Number
Regular operators.....	3
Temporary or substitute operators.....	1
Total.....	4

All accidents involving shuttle-car operators occurred underground in bituminous coal mines.

Manner in which shuttle-car operators suffered fatal injury.

	Number of occurrences
1. Killed by contact with low roof or cross bar.....	2
2. Caught between rib, post, and shuttle car.....	2

The following pertinent data present the causes for each manner of occurrence.

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	Number of occurrences
1. Victim killed by contact with low roof or crossbar.	
(a) Action of victim at time of accident.	
1. Jerked upright in seat by sudden bounce of moving shuttle car.....	2
(b) Physical hazards contributing.	
1. Irregular or scant vertical clearance.....	2
2. Irregular bottom, rolls, miscellaneous debris.....	2
(c) Unsafe practices involved.	
1. Riding in unsafe position.....	1
(d) Contributing causes.	
1. Mental lapse, lack of alertness.....	1
2. Caught between rib or post and shuttle-car.	
(a) Action of victim at time of accident.	
1. Head turned watching the rear of the shuttle car while making a 90-degree turn.....	2
(b) Physical hazards contributing.	
1. Uneven rib protruding with overhang.....	1
2. Insufficient clearance to maneuver.....	1
3. Substandard timbering.....	1
(c) Unsafe practices involved.	
1. Leaning beyond the side of moving shuttle cars.....	2
2. Not facing direction of travel.....	2
(d) Contributing causes.	
1. Inattention.....	1
2. Inexperience.....	1

Remarks.

The principal causes of shuttle-car injuries are:

1. Contact with low roof or crossbar.

2. Contact between rib or post and shuttle cars.

3. Falling from or being jerked from moving shuttle cars.

4. Caught by fall caused by shuttle cars knocking out roof supports.

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5. Struck by moving shuttle cars.

6. Collisions between parked equipment and shuttle cars.

7. Caught by shuttle-car conveyor chain while unloading supplies or doing other work.

The principal physical hazards contributing to these types of accidents are:

1. Inadequate maneuvering space.

2. Wet or irregular bottom.

3. Poor timbering at intersections or entries.

4. Mechanical failure of brakes and steering.

5. Cramped and unprotected operators seat.

6. Uneven, protruding, or overhanging ribs.

7. Miscellaneous hazards common to haulage roads and equipment operation.

The prevalent unsafe practices involving injuries to persons are:

1. Not looking in the direction of travel.

2. Rising from seat.

3. Leaning out over side of moving shuttle car.

4. Jumping off or onto moving equipment.

5. Riding in unsafe positions.

6. Not sounding warning gong at blind locations.

7. Excessive speed.

8. Operating unfamiliar equipment.

9. Horseplay.

10. Trying to grab or touch something from moving shuttle car.

Description of Accidents

1. The victim made three previous trips and experienced difficulty with the irregular and wet bottom. Upon entering the working place, a small bottom roll caused the shuttle-car to bounce, and the deceased was crushed between the roof and the shuttle car.

2. The victim, operating a shuttle car, turned to watch the rear of the car pass through a check curtain. He did not notice that the car was headed toward the rib and was crushed.

3. The victim, a substitute operator, was killed while making a 90-degree turn under a timbered intersection that did not provide enough clearance. He had turned his head to watch the rear of the shuttle car.

4. The victim, riding too high in the seat of a shuttle car, was jerked against the roof by a sudden bounce of the car.

Interior - Bureau of Mines, Pittsburgh, Pa.

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